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SEAGRASS COMMUNITY STRUCTURE IN TUNDA ISLAND GULF OF BANTEN

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ABSTRACT

Seagrass, as an aquatic angiosperms which are completely adapted to live in the marine environment and shallow water estuaries, is one of the most highly productive marine ecosystems. Under the increasing of global water temperature, coupled with nutrient over-enrichment, the community structure of seagrass may transform as the alteration of ecological functions followed. This condition may also happen in Indonesian coastal waters, including Tunda Island on the Gulf of Banten which received excessive nutrients from the mainland. Study of seagrass community in Tunda Island has been carried out using line transect method perpendicularly to the shore with the 1x1 meter transect plots within 10 meters interval. Community structure as density, coverage, diversity index and dominance index of seagrass had been observed in 4 stations. The results showed that there were five species of seagrass were recorded in this area, namely Cymodocea rotundata, Syringodium isoetifolium, Enhalus acoroides, Halophila ovalis and Thalassia hemprichii. The distributions and species composition were varied and generally dominated by Thalassia hemprichii with 48.25 shoots m^{*2} *density. The diversity index obtained from the research was 0.84 as well as the dominance index was 0.55. It showed that the diversity of seagrass at Tunda Island is low and no high dominance among species. The status of seagrass meadows in Tunda Island was classified as poor since the total coverage was only 22 %. Further observation of correlation among other organisms such as macroalgae and grazers in the ecosystems will be necessary to investigate the ecological alteration.*

Keywords: Community structure, Damage, Diversity, Gulf of Banten, Seagrass

INTRODUCTION

Seagrass are specialized marine flowering plants which adapted to live submerged in water. Seagrass in Indonesia are extensive and diverse which the areas of seagrass meadows in Indonesia reach 30.000 km^2 (Nontji 2009). Seagrass have been ranked as one of the most ecologically and economically valuable biological systems on earth (Duarte 2002). They play an important role in converting sunlight and carbon dioxide efficiently into organic forms, regulating nutrient cycles, stabilizing sediments in which they grow and acting as nursery and spawning ground for many commercially caught species (Hogarth 2007).

Seagrass meadows can be highly dynamic, changing as a result of both natural and anthropogenic influences (McKenzie et al. 2004). It is now accepted that as the world's climate is changing the concentration of carbon dioxide in the atmosphere has increased, and means global temperature and sea level has both risen, and is likely to continue to do so (Hogarth 2007). Continued rise in sea level will increase the depth of coastal waters and will cause inland and upstream salinity intrusion, both of which will affect submerged vegetation. While there is uncertainty regarding the influence of global warming on the frequency and intensity of storm events, sea-level rise alone has the potential for increasing the severity of storm surge, particularly in areas where coastal habitats and barrier shorelines are rapidly deteriorating. Elevations in sea-level and increases in the intensity of extreme events such as storms and cyclones will reduce light availability and are expected to negatively impact seagrass (Connolly 2009).

The need for increased understanding today has taken on a new meaning, and urgency, as the rate of seagrass loss appears to be accelerating concurrently with the rapid urbanization of the coastal zone, where seagrass are most abundant (Green and Short 2003). The effects of loss of seagrass along the coastline include a change in the structure of the community which provides no habitat for many important marine organisms, loss of marine biodiversity and increased sand erosion. Since different species of seagrass support different food webs, changes in the community composition of seagrass will be propagated into changes at higher levels in the food chain (Environmental Protection Agency 1998).

One of the coastal areas that have been reported suffered damage on seagrass due to the human impact is Gulf of Banten where Tunda Island is closely located. A regular observation on seagrass community structure related to the alteration of the coverage area and the composition of seagrass is required due to the condition of the seagrass meadows is predicted to be decline over years.

MATERIALS AND METHODS

1.Site Description

The study was conducted on January 2014 at Tunda Island, Gulf of Banten. Community structure as density, coverage, diversity index and dominance index of seagrass had been observed in 4 stations. Station I located on the south-west, Station 2 on the south-east, Station 3 on the east and Station 4 on the north side of the island.

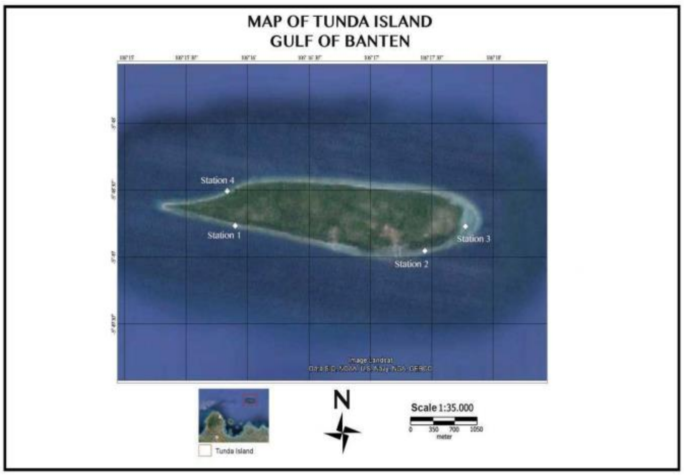

Figure 1. Map of the Observation Sites in Tunda Island, Gulf of Banten

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Table 1. Position and Description of the Substrate of the Observation Site

Location	Position	Description of the Substrate
Station 1	106° 15' 54.072 E 5° 48' 45.9036" S	sand, rubble, dead and life coral
Station 2	106° 17' 26.7" E 5° 48' 57.2256" S	muddy-sand
Station 3	106° 17' 46.5108" E 5° 48' 46.1844" S	sandy-mud
Station 4	106° 15' 50.166" E 5° 48' 30.3336" S	sand, rubble, dead and life coral

2.Data Analysis

Study of seagrass community in Tunda Island was carried out using line transect method modified from English et a1. (1994). Three line transects (50 meter each) were distributed parallel, 25 meter apart to each other and perpendicular to the shore. Quadrates sampled every 10 meter with the 1x1 meter transect plots. Data collected include seagrass species composition, estimation of its percent cover, density and the type of sediment. Meadows cover, the percentage of substrate covered by the seagrass leaves, was determined by the visual estimation (Short et al. 2006).

The density of seagrass calculated with the following formulas:

$$D_x = n_x / A \quad (1)$$

Where
D_x : Density of Species x
n_x : Numbers (Individuals) of Species x
A : Total Area of the Observation Sites

The diversity of seagrass calculated with Shannon-Wiener diversity index:

$$H' = \sum P_i \ln P_i \quad (2)$$

Where
Pi : n_x / N
N : Total number of the individuals

The dominance of seagrass calculated with Simpson Index of Dominance:

$$C = \sum (P_i)^2 \quad (3)$$

RESULTS AND DISCUSSIONS

1. Physical Parameters

Results of the physical parameters measured can be seen on the table 2.

Table 2. Results of the Physical Parameters Measured in Tunda Island

Parameter	Station 1	Station 2	Station 3	Station 4
Temperature (°C)	28-29	28-29	28-29	28-29
Salinity (‰)	31	30	29	31
pH	8	8	8	8
Light (%)	100	100	100	100
Depth (meter)	0,3	1	0,6	0,2

Tropical seagrass are found in prescribed physical conditions. Temperature and salinity determine the range and extent of the seagrass meadows. Seagrass themselves can alter the physical and chemical environment once they become established and propagate vegetatively via rhizomes. Temperatures of Tunda Island waters were relatively homogeneous from 28 to 29"C. This temperature is optimum for seagrass growth, according to Marsh et at. (1986) the optimum temperature range for seagrass growth is 25-30°C. This temperature range is suitable for seagrass to perform photosynthesis activity. According to Nybakken (1992), the influence of water temperature on seagrass is very large. Temperature can affect the physiological processes of photosynthesis, growth and reproduction. The physiological process will decrease sharply when the water temperature is outside the optimum range.

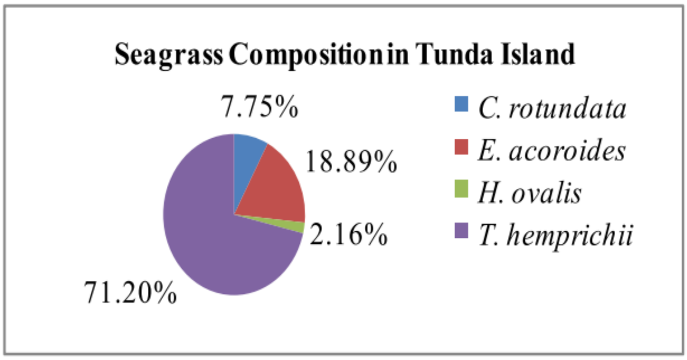

Figure 2. Species Composition of Seagrass in Tunda Island

Salinity measurements were performed at the time of the observations results the salinity in Tunda Island ranged from 29 to 31 practical salinity units (psu). One of the factors that affect the salinity is the presence of freshwater input. Panjang Island, which is located close to the Tunda Island, has a salinity range from 28,5 to 30 psu (Sakarudin 2010). Seagrass have a wide range of tolerance to salinity, from 10 to 40 psu. The optimum value of tolerance to salinity in seawater is 35 psu, a decrease in salinity will reduce the photosynthesis ability of seagrass (Dahuri 2001). Seagrass species are generally euryhaline but in seriously hyposaline (<10 psu) or hypersaline (>45 psu) conditions, they suffer stress and are likely to become necrotic and die (Hemminga and Duarte 2000). The greatest damage to seagrass meadows can occur during natural disasters, such as hurricanes, when a large quantity of fresh water run-off enters shallow coastal areas.

Tunda Island has a relatively homogenous pH on the entire observation sites, which are 8. The pH is in accordance with the quality standard based on the Ministry of Environment No. 51 Year 2004 that seawater pH in the range from 7.24 to 8.08. It is also in accordance with the statement of Schubell and Burrell (1977) which states that the optimum pH for seagrass growth is 7.3 to 9.0.

The irradiance in Tunda Island during observation was relatively homogenous on the entire sites, which is l 00%, this is due to the depth of the observation sites tend to be shallow, about 0.2 to 1 meter. Seagrass generally require irradiance greater than about 11% of that at the sea surface, which in practice means that they are restricted to a few tens of meters depth (Hemminga and Duarte 2000). Below the minimum light requirements, seagrass will die, as light intensity increases seagrass growth will increase linearly (Short et a1. 1995). Different species of seagrass have different light requirements and depth distributions, a reduction in light reaching the substrate may change seagrass species composition by enhancing growth of species having lower light requirements or may reduce depth of distribution.

2. Species Composition

There are five species of seagrass were recorded in Tunda Island, namely *Cymodocea rotundata, Syringodium isoetifolium, Enhalus acoroides, Halophila ovalis* and *Thalassia hemprichii.* Based on the number of seagrass species found in Indonesia as many as 12 species, Tunda Island has 41.67% species composition of all seagrass in Indonesia. From all of the seagrass that has been identified, *S. isoetifolium* found at Station 4 was not include in the transect plot on the line transect so that it can't be analyzed quantitatively. Species composition based on the number of individual found in Tunda Island can be seen on figure 2. The distributions of seagrass in Tunda Island were varied and it can be seen on the table 3.

The distributions of seagrass in every station were varied. Species *T. hemprichii* was the most abundant and evenly distributed in the entire station however the *H. ovalis* only found at station 3 and 4. Species f. *acoroides,* which was only found at station 2, it was suspected that the muddy-sand substrate was suitable for *E. acoroides* growth. This species was grown well and reach 1 meter in height. This is due to the condition of the waters close to the residents so that the nutrient content in waters was high. Species *C. rotundata* was found at station 1 and 2 with a low number of individuals and the growth was not as good as *E. acoroides.*

Table 3. Distribution of Seagrass in Tunda Island

Species	St. 1	St. 2	St. 3	St. 4
C. rotundata	√	√		
E. acoroides		√		
H. ovalis			√	√
T. hemprichii	√	√	√	√

Based on the table 3 species *T. hemprichii* has the highest distribution. This showed that *T. hemprichii* has a better adaptability among all species (Resosoedarmo 1985). This species was distributed in the entire stations due to its ability to grow well in muddy-sand and rubble substrate (McKenzie et al. 2003). Species *C. rotundata* and *H. ovalis,* however, have a low distribution. *C. rotundata* was only found in the intertidal zone and *H. ovalis* was only found in shallow waters. This is conformed Hutomo (1997) that state *C. rotundata* is one of the species dominant in intertidal zone. *H. ovalis* with its narrow leaves has the same distributions as *E. acoroides,* but its presence limited to the shallow waters, so that if there is any turbidity process, the light penetration still reach the bottom of waters partially and this species still has the opportunity to keep growing and photosynthesize.

Density is one elements of the community structure that can be used to estimate seagrass productivity (Mukai et al. 1980). Species *T. hemprichii* has the highest density, with 48.25 shoots m^{-2} or equal as 71.19 % of all species. This showed that *T. hemprichii* has the highest population in Tunda Island. A high density could influence seagrass coverage estimation. Seagrass coverage is related to the morphology and the dimension of the species. One individual *of E. acoroides* has a higher coverage value or looked denser compared with one individual of *Halodule uninervis* since *E. acoroides* has a bigger in leaves size while a small one such as *Halophila minor* will has a lower coverage value (Short and Coles 2001).

Species *E. acoroide.s* growing very well and causing the coverage of this species is more dominant than the other species. But its distribution which only located at station 2 makes this species is less dominant than *T. hemprichii* which evenly distributed in the entire station. Species *T. hemprichii* was the most dominant species which has a wide distribution. It indicated that the presence and dominance of this species is quite high and its presence in the seagrass meadows community is very important. If this species appeared to be loss the ecosystem will be disrupted. *T. hemprichii* is the most dominant species and has a wide distribution. This species is found in almost all of waters in Indonesia and often dominate mixed vegetation as well as grow in various types of substrate from muddy-sand, fine and coarse sand to the rubble.

Species diversity and species dominance were evaluated by using Shannon-Wiener diversity index and Simpson index of dominance in order to determine the biodiversity and the dominance of seagrass. Species diversity index obtained from the entire observation sites was 0.84, it indicated the seagrass diversity in Tunda Island was low. This low diversity is due to the condition of the near-shore as the habitat for seagrass was less suitable for the other species to grow. A number of species is one of the things that determine species diversity index. A high diversity shows a high complexity in a community due to the interaction among all species is high (Moore and Chapman 1986). Varied topographies also affect the diversity of the seagrass. However, the dominance index was 0.55 showed that there was a species which tend to dominate the community yet its dominance was not quite high.

Based on the Decree of Minister of the Environment No. 200 Year 2004 on standard criteria, guidelines for determining the extent of damage and the status of seagrass, seagrass coverage ≥ 60 % were classified as rich/healthy, 30-59.9% as less healthy and ≤ 29.9 % as unhealthy. It can be concluded that the status of seagrass meadows in Tunda Island was unhealthy because the total coverage of the seagrass meadows was 22 %.

CONCLUSION

The distributions and species composition were varied and generally dominated by Thalassia hemprichii. The diversity of seagrass is low and no high dominance among species. The status of seagrass meadows in Tunda Island was classified as unhealthy since the total coverage was only 22 %. The world's climate change is leading into the increase of the carbon dioxide concentration in the atmosphere and continued with the rise in sea level which will increase the depth of coastal waters. This condition will lead into the loss of seagrass ecosystem including Tunda Island on the Gulf of Banten which also encounters anthropogenic threat by receiving excessive nutrients from the mainland.

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